

Influence of selected bronchodilators used in chronic obstructive pulmonary disease on Langmuir monolayers serving as models of lung surfactant

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Lung surfactant (LS) is a layer lining alveolar epithelium, which is composed of approximately 90% of lipids by weight and 10% of proteins. It has an essential role in the process of breathing and in minimizing entering of inhaled particles into the bloodstream [1]. Recently conducted research showed decreased total phospholipid amounts in lung surfactant of COPD patients [2]. Chronic obstructive pulmonary disease (COPD) is a common incurable lung disease, which is one of the leading causes of death worldwide. The main goals of COPD management are to alleviate symptoms and prevent exacerbations. Recommended treatment are inhaled bronchodilators: muscarinic antagonists and β_2 -adrenoreceptor agonists [3,4].

Our research objective is to deepen knowledge about the influence selected inhaled drugs used in COPD have on the surface properties of models of lung surfactant. In order to achieve this goal we used models mimicking lung surfactant of a healthy person which reflected simplified LS composition: DPPC:DPPG (8:2) and DPPC:Chol:DPPG (7:1:2) and as a model imitating lung surfactant of a COPD patient: DOPC:Chol:DPPG (7:1:2). We have recently also started investigating models of LS containing ether PC lipids which are second most abundant class of phospholipids in LS [2]. We studied the effect of selected bronchodilators including tiotropium bromide (TTB) on lung surfactant models. Research was carried out with the use of Langmuir technique, Brewster Angle Microscopy (BAM), compression-expansion experiments, oscillating barriers method, grazing incidence X-ray diffraction (GIXD) and total reflection X-ray fluorescence (TRXF). All these methods enabled us to characterize the organization of the monolayers, tendency of the monolayers to form assemblies and their reorganization, viscoelasticity of the monolayers as well as lateral 2D packing of the monolayers and their changes upon the exposure to selected drugs. Moreover TRXF allowed for detection of TTB in the monolayer.

Obtained results show that changes in the surface properties of the monolayers upon exposure to drugs are dependent on the model of lung surfactant. Model monolayers mimicking lung surfactant of a healthy individual and person suffering from COPD differ in the ability to incorporate selected drugs and in the effect on the organization. Moreover, they vary in the influence of the investigated drugs on the ability to reorganize when expanded and on the elasticity.

Keywords:

Lung surfactant, chronic obstructive pulmonary disease, Langmuir technique, BAM, compression-expansion experiments, oscillating barriers method, GIXD

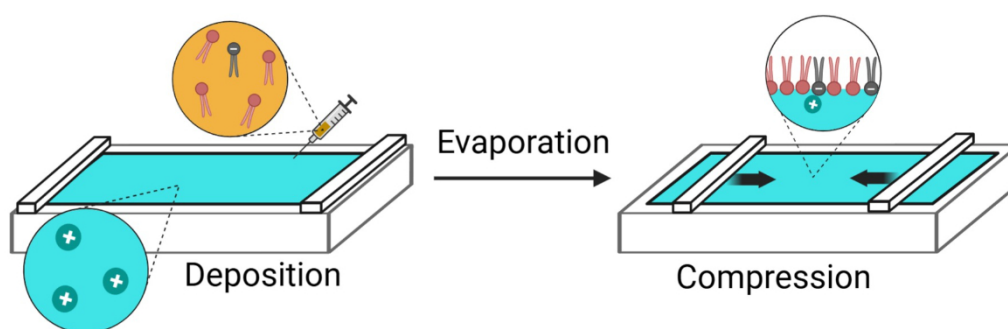


Figure 1. Schematic illustration of the preparation of experiments.

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